Classification and Analysis of Methods of the Channels Distribution in Multichannel Mesh Networks IEEE 802.11

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Abstract – **In this paper was carried out a review and classification of existing channels distribution methods in multichannels mesh network of IEEE 802.11 standard.**

Keywords – **Wireless Mesh Network, the distribution channels, transmission range, multiradio, multichannel.**

I. Introduction

To improve the performance of mesh networking standard, IEEE 802.11x is used a number of effective approaches that have ensured the growth of radio channel throughput. Among the facilities data link and network layer the approach based on the using the multiradio multichannel construction and mesh networks operation deserves special attention. The usage of networks multiradio multichannel wireless mesh networks (MR-MC WMN) can reduce interference level and thus improve mesh network productivity from two to five times depending on the number of used channels, the density of mesh stations (users) and the accepted traffic characteristics. Currently, there are plenty of problem formulation and problems solving methods of the channels distribution in MR-MC WMN, being different with different account of technological peculiarities level mesh networks and separate stations, of served traffic characteristics, etc., which significantly affects upon the calculation of the desired final result and determines application area of a method. In this regard, the actual problem is related to the review and classification methods of channel distribution between the radio network interface cards (NICs) of stations in MR-MC WMN of IEEE 802.11 standard.

II. Results of Analysis and Classification

The classification is traditionally based on the ordering and grouping of these objects according to their common features. The purpose of the classification of existing methods of channels distribution is to identify their strengths and weaknesses, as well as to determine the conditions and their applications in networks of MR-MC WMN standard IEEE 802.11.

In the result of analysis the entire multitude of existing methods of channels distribution in MR-MC WMN can be classified in the following attributes:

- referring to the topology;
- the degree of traffic accounting;
- the number of NICs on mesh stations;
- to the channels distribution localization;
- for administration purposes;
- in terms of sequence private problems solution;
- on the method of administration;
- on the dynamics of the problem solving;
- in the form of the interaction between the stations account.

On the given topology the entire multitude of methods of channels distribution can be divided into methods using the tree topology networks, and methods, dividing the network into clusters. In methods using the tree topology of the network [1], each mesh station can operate in two modes: station «parent» and «child» station (Fig. 1). The station is the «parent» if it is located in the tree hierarchy to one level higher of the «child» station and is responsible for appointing channels between their «child» stations. «Child» station can be connected to only one «parent» station.

In the methods of dividing the entire stations multitude into clusters [2, 3], within each cluster is allocated an admin station - a leader, who is responsible for the channels distribution in the cluster. Thus, within a cluster, all stations (except the leader) are equal (Fig. 2).

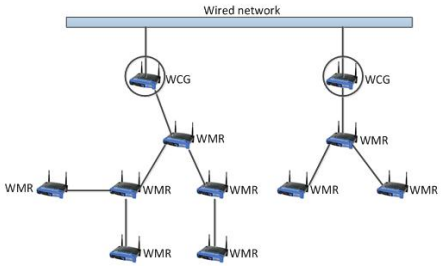

Fig.1. The tree topology is mesh network, where WCG - Wired Connectivity Gateway, WMR - Wireless Mesh Router

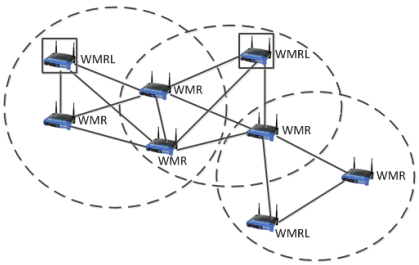

Fig.2. The topology of mesh network decomposition into clusters, where WMRL - Wireless Mesh Router Leader

Also, all the variety of methods to channels distribution is classified according to traffic accounting circulating in the mesh network. There are methods, which provide the channels distribution, taking into account the characteristics of traffic

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over the network [4], including methods in which such records are not produced [2, 3, 5].

In addition, methods can be classified by the number of NICs used at the stations in WMN. We can distinguish methods of channels distribution in homogeneous mesh networks [2, 3, 5], when the NICs number at all mesh network stations is equal (Fig. 3). Also highlighted the methods used for heterogeneous mesh networks [2, 3], when the NICs number at different mesh network stations can differ (Fig. 4).

Methods of channels distribution in multichannels network can also be divided by the dynamics of the channels distribution problem solution. At the same time there are methods of static channels distribution [1-3, 5, 6], where the channels appointment is carried out one time, usually at the mesh network design stage, or reassigning channels for the NICs is quite rare. Also highlighted the methods of dynamic channels distribution [7], when the channels are reallocated in real time - on demand or periodically. It should also provide hybrid methods [8], where part of channels is reassigned between the NICs through a certain fixed period (timer), and part of the channels switches at the request of certain stations.

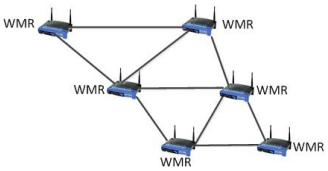

Fig.3. Homogeneous WMN

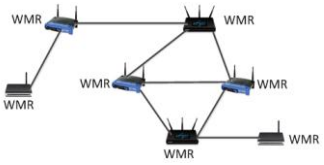

Fig.4. Heterogeneous WMN

Methods of distribution channels can be classified by administration purposes. At the same time highlighted the methods aimed at maximizing the number of active bidirectional connections between the mesh network stations [5]. There are also methods that allow the channels distribution with purpose to improve the productivity of WMN as a whole [2-4]. In the process of the channels distribution other criteria's can be used.

Besides, the analyzed methods are classified by location channels distribution, highlighting the two types of methods. The first locally-consistent methods, find a solution on the channels distribution in series consequently for each separate station or group of mesh network stations [1, 4, 6]. Second, the so-called global methods [2, 3], make the channels distribution between all mesh network stations in general.

Finally, the entire multitude of analyzed methods can be classified in terms of sequence of the private problems of channels distribution. At this the following problems can be private [2, 3, 6]:

1) the decomposition of mesh networks into clusters;

2) the distribution NICs mesh stations between the clusters;

3) the consolidation of channels for each of NICs stations.

Highlighted methods that solve the general problem of channels distribution is by consistent of these private problems solution [6]. Also known solutions, in which the problem of channels distribution is solved in a whole providing a simultaneous and mostly coordinated solution of similar private problems [2, 3].

Methods of channels distribution can be classified by type interaction between the stations of account. At the same time there allocated a multitude of methods [8], regulating the channels distribution on the basis of direct ties. Besides there a number of methods that provide a account of the interaction of range principle can be also highlighted [1-3]. Such areas may be the communications range and the interference range.

III. Conclusion

This method classification has allowed to ascertain the presence sufficiently wide range of approaches to the formulation and problem solution channels distribution in MR-MC WMN standard IEEE 802.11. These methods, depending on the conditions of mesh network and operation used the initial data can find and have found their application implementation. Under this classification and the present bibliography of publications on this subject [1-8] can be traced the increased attention to the channels distribution problem in MR-MC WMN standard IEEE 802.11, and to methods for their solution.

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